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SWEET CLOVER
IN
WESTERN CANADA

J. E. R. Greenshields

Forage Crops Laboratory, Saskatoon, Sask.

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SWEET CLOVER IN WESTERN CANADA

J. E. R. GREENSHIELDS

Forage Crops Laboratory, Saskatoon, Sask.

Sweet clover has become one of the most important legumes in the Prairie Provinces of Canada and in the central and northern regions of the United States. Its popularity is due to its value as a forage and as a soil improving crop. Sweet clover is equal to alfalfa in feeding value. It has a characteristic bitter stinging taste, and livestock will often show a preference for it once they become accustomed to it. It is at least as valuable as alfalfa or red clover for soil improvement. Because of its drought resistance, it is adapted to the drier areas of Western Canada where, without irrigation, red and alsike clovers are unadapted.

Sweet clover can be grown successfully on a variety of soil types. The rich loams and clay loams are preferable but excellent crops may be grown on fine sandy loams and heavier clay soils as well as on gray wooded soils of low fertility. Soils that contain sufficient alkali salts to prohibit the production of cereal crops will often produce excellent crops of sweet clover. Acid soils are not suitable. Fortunately most soils in Western Canada are slightly alkaline in reaction. Land that is subject to flooding for more than about ten days in the spring should not be sown to sweet clover.

Management of the Crop for Various Purposes

Pasture

When properly managed sweet clover is one of the most productive pasture crops available. It is suitable for cattle, horses, sheep, and hogs. Best results are obtained when grazing is begun early in the second season. Early grazing checks the upright growth and causes the plants to branch more freely. Though it is not desirable to overgraze the pasture, sufficient livestock should be kept on it to prevent the plants from becoming coarse and woody. It is suggested that enough animals be pastured to maintain growth at 10 to 15 inches high.

Cattle and sheep may bloat on sweet clover pasture. However, the chances of this occurring are not so great as with alfalfa pasture, and certain management practices will reduce the danger. Cattle should not be turned into sweet clover for the first time when they are hungry or when the pasture is wet with rain or dew. Before turning livestock in for the first time in the spring it is a good practice to let them have all the dry roughage they will eat. Permitting the stock access to dry feed such as straw or hay while pasturing sweet clover will reduce the bloat hazard. Hundreds of acres of sweet clover are pastured each year in Western Canada and losses are rare.

Hay

When sweet clover is cut at the proper stage and cured under favorable conditions all classes of livestock eat it readily. As a roughage for growing stock and for dairy cattle it is equal to alfalfa hay. Spoiled sweet clover hay frequently causes "sweet clover disease". (See section on sweet clover poisoning).

To make the best quality hay the crop should be cut not later than the opening of the first flowers. The hay requires a slightly longer time to cure when cut at the less mature stage, but when cutting is delayed the hay becomes coarse and woody.

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Hay-making practices vary widely. If harvested with the binder, the sheaves should be made relatively small and tied loosely. The hay is cured by placing the sheaves in very small or long narrow stooks and allowing them to remain until ready for storing. This method prevents excessive loss of leaf, but has the disadvantage that the stooks interfere with the second growth, if curing is delayed due to unfavorable weather. In addition, the butts of the sheaves, which are constantly in contact with the soil, dry slowly and may become moldy.

When the crop is cut with the mower it should be raked into the windrows before the leaves become dry enough to shatter and left to cure in windrows or cocks. The crop may be cut with a swather but the swath dries less rapidly than when cut with a mower and raked into a windrow when partially dry. The dry hay must be handled as soon as possible, since unnecessary handling causes a heavy loss of leaf which results in low quality hay.

In moist areas of the province, it is often possible to get two cuttings of hay. When two cuttings are desired it is important to make the first cutting early, just before flowering starts, and to leave a stubble 8 to 10 inches high.

Silage

Sweet clover is very satisfactory for the making of silage. The crop is cut with a forage harvester about one week or ten days later than would be recommended for hay. The optimum moisture content of any silage crop is from 65 to 75 percent. In most years sweet clover tends to be somewhat more moist than is necessary for silage; this may be overcome by allowing the sweet clover to wilt in the swath for about one hour on a sunny day or somewhat longer on a dull day. The grasses and cereals often are below the optimum in moisture content for silage making and if they can be mixed load for load with sweet clover in the silo the quality of the silage will be greatly improved. The silage should be packed firmly and thoroughly or considerable spoilage will result. Spoilage is particularly dangerous in sweet clover because of the possibility of "sweet clover disease". As mold is bound to occur at the surface of the silo it is advisable to fill the last foot with some crop other than sweet clover. If the silo is topped with sweet clover the moldy layer should be discarded and not fed to livestock.

Straw

When harvested for seed the straw will provide a roughage of considerable value. Although woody in appearance, it has considerable nutritive value and the bitter taste found in sweet clover hay is almost absent. Stock eat it readily, especially if it is put through a cutting box. Dairy farmers have reported excellent results from feeding sweet clover straw.

Soil Improvement

Sweet clover is used extensively in the more humid regions of Western Canada to improve soil fertility and soil structure. It is particularly valuable for this purpose in the Gray Wooded and Degraded Black and Black soil areas. In the drier areas it is usually impossible to demonstrate any benefit from plowing down sweet clover.

Improvement in soil structure and in organic matter content results in increased moisture absorbing capacity. This in turn reduces the susceptibility of the soil to water erosion. However, if the forage is removed sweet clover has little value for wind erosion control since it leaves the soil extremely loose and dry.

Plowing or one-way disking the entire crop provides maximum soil improvement. Such a practice is particularly desirable on gray and degraded black soils and on black soils which have been producing heavy grain crops.

In such cases plowing may be done late in the fall of the first year or any time before the crop makes 10 to 12 inches of growth in the spring of the second year. The clover is more easily killed after it has begun spring growth than before this stage. When a crop is allowed to reach a more advanced stage before being plowed down it removes a great deal of moisture and the large amount of organic matter tends to dry out the soil as well as cause a temporary disturbance to the balance of nutrients in the soil. An alternative is to plow in the straw after the seed crop is combined. This is more easily accomplished where a straw spreader has been used on the combine. With a tall rank growth the large volume of straw may be difficult to bury and may have the above noted effects on the soil.

The question of whether to plow the entire crop down or to remove a hay crop and then plow is a difficult one to answer. The relative use for hay as compared with the need for soil improvement is the deciding factor and in general this decision has to be made on an individual farm basis. In making the decision it must be realized that when a hay crop is removed before plowing, the amount of nitrogen and organic matter available for soil improvement is small compared with that obtainable by plowing down the entire crop. Where the response from plowing down sweet clover is large then sacrificing the hay crop for soil improvement may be justified. This latter situation is most likely to exist on the gray and on the degraded black and perhaps black soils. Where responses to plowing down are not pronounced removal of a hay crop before plowing down may provide all the soil improvement that is required.

When the sweet clover is used for pasture much of the nutrients contained in it are returned to the soil in the dung and urine.

Seed Production

A seed crop may be produced for sale or to provide the seed requirements of the farm. Yields vary greatly but under good conditions may exceed 1,000 pounds per acre. The price to the farmer has ranged from 3 to 30 cents per pound during the last ten years and it is difficult to predict the future.

Honey-bees are essential to seed setting, especially in the case of common yellow blossom sweet clover. A concentration of about one colony per acre of honey bees is desirable.

Flowers of the crop are very susceptible to damage from 2,4-D. Drift spray or dust may cause the flowers to drop. Usually the plants will flower again but the seed crop may be so late that it will not mature. Every precaution should be taken to avoid damage from 2,4-D. If D.D.T. is applied to sweet clover for insect control with the same machine used for the application of 2,4-D, the machine must be thoroughly washed between operations.

Seed pods turn white, dark gray, or brown when mature. The crop should be cut with either a binder or a swather when two thirds of the seed has matured. If left standing beyond this stage some of the early seed will drop and the loss through shattering will exceed the amount gained through ripening.

Standard swathers may be used to cut sweet clover. When the swath has had time to dry it is picked up. Sometimes the swath is so fluffy that it does not feed well into the combine. This difficulty may be overcome by having a man sit on the front of the combine above the conveyor and use a long pole to press the swath into the elevator. Some farmers have mounted a small auxiliary reel directly in front of the conveyor from the auger platform to the first feeder. Considerable seed can be saved by swathing and picking up in damp weather.

When swathers and pick-ups are not available the sweet clover can be harvested satisfactorily with a grain binder. The sheaves should be set in

very small or long narrow stooks. Some shattering of the seed normally takes place during harvesting. A shallow pan or box attached to the frame of the binder under the opening between the table and the elevator canvas will catch the seed that falls on the table canvas.

When threshing with an ordinary grain separator, best results are generally obtained when only one row of concave teeth is used. The concaves should be set well away from the cylinder. If most of the pods are left on the seed the cleaning of the seed is simplified.

Straight combining of sweet clover for seed has not proved satisfactory as much of the seed has dropped by the time the stems are dry enough to combine.

Cleaning the Seed—The success with which sweet clover seed may be cleaned on the farm with an ordinary fanning mill will depend upon the kinds of weed seeds present and the proportion of the sweet clover seeds that remain enclosed in their seed pods. The seeds of many weeds are similar in shape, size, and weight to the naked sweet clover seeds and are difficult to remove. However, sweet clover seeds that are enclosed in their pods are large enough to enable separation to be made with suitable sieves. If larger weed seeds are present they can be removed after the pods have been removed from the sweet clover.

The following sieves have been found useful when cleaning sweet clover seed with the ordinary fanning mill:

Top Sieve			Bottom Sieve		
Kind	Shape of opening	Size of opening	Kind	Shape of opening	Size of opening
Zinc	Circular	5/64 inch	Zinc	Circular	3/64 inch
Zinc	Circular	9/128 inch	Zinc	Circular	7/128 inch
Wire	Square	14 x 14	Wire	Oblong	4 x 22
Wire	Square	16 x 16	Wire	Oblong	4 x 24
			Wire	Square	20 x 20
			Wire	Square	22 x 22

Sweet clover seed, like that of other crops, varies in size and weight from season to season, depending upon the conditions under which the crop is grown. It is advisable to have a range of sieve sizes that will take care of these seasonal variations in seed size.

Improvement of Alkali Soils

Sweet clover is frequently sown on land that contains sufficient alkali salts to prohibit the growing of wheat, oats, or barley for grain. Not only will the sweet clover produce heavily on these alkali soils, but it frequently happens that one or more crops of cereals may be taken off the land following the sweet clover crop. For maximum benefit to the soil the entire sweet clover crop should be plowed down.

As Bee Pasture

Sweet clover is the most widely used of our cultivated plants for bee pasture. Under favorable conditions, it produces a large amount of nectar that makes a high quality honey. It is generally agreed that at least one acre of sweet clover left for seed is required for each strong colony of bees. However, under dry conditions, the amount of nectar produced is somewhat less than where moisture conditions are more favorable and a concentration of less than one colony per acre may be adequate.

Under favorable conditions, sweet clover continues to flower over a fairly long period, but in the drier areas it has a tendency to ripen off early and the flowering period seldom lasts more than thirty or thirty-five days. The amount of nectar produced under such conditions is relatively small. It is, however, possible to increase the duration of the flowering period by harvesting part of the sweet clover field for hay just before the first flowers open. A stubble 6 to 8 inches high should be left. The uncut portion of the field, if left to mature seed, will provide blossom, in the case of the standard varieties, during most of July. During August and September the second growth from the early harvested area will normally provide a mass of bloom.

Experiments conducted at Saskatoon indicate that the flowering period may be greatly lengthened by growing several varieties that flower at different periods. For instance, the common yellow sweet clover usually begins flowering about one week earlier than the white blossom varieties. "Redfield Yellow", on the other hand, usually begins flowering about three weeks later than white blossom sweet clover and continues to produce flowers for almost a month after common white has ceased blossoming. If a portion of the sweet clover acreage on the farm is sown to each of these three kinds, the pasture season for bees will be much longer than if only one variety is grown.

Description of Varieties

Of the many known species of sweet clover only three are commonly grown under cultivation. These are the white flowered biennial, *Melilotus alba,* and the yellow flowered biennials, *Melilotus officinalis* and *Melilotus suaveolens.* Of these the white flowered biennial is used most generally while the *M. suaveolens* is used to a very limited extent.

Common White *(Melilotus alba).*—This is a tall growing, coarse stemmed variety. It is unselected and therefore comprises many varied types of plants. It is quite winter hardy but less so than the variety Arctic.

Arctic (*Melilotus alba*).—This variety is the standard white blossomed variety in Western Canada. It was selected out of Common White for its hardiness, medium fine stem, leafiness, and high yield. It is also earlier maturing than Common White. It is more widely grown than any other sweet clover variety in Western Canada.

Alpha *(Melilotus alba).*—Alpha is a dwarf type of white blossomed sweet clover, one half to two thirds as tall as Arctic. It is characterized by its many very fine stems, and great leafiness. This variety is lower in yield than Arctic, but in the more moist Black soil and Gray Wooded soil zones it yields satisfactorily and the hay is not so coarse as other varieties such as Arctic. Alpha was developed by the University of Saskatchewan.

Brandon Dwarf *(Melilotus alba).*—This variety is very similar in characteristics to Alpha and is adapted to similar conditions. It was developed by the Experimental Farm at Brandon, Man.

Common Yellow *(Melilotus officinalis).*—This is the unimproved yellow flowered sweet clover. Like Common White it is a mixture of many varied types. It is somewhat shorter growing and less upright than Common White and has many branches that tend to be prostrate. It generally flowers a few days earlier than the white blossomed varieties. Hay yields of this variety have been equal to those of Common White and Arctic.

Erector *(Melilotus officinalis).*—This variety, selected from Common Yellow, at the Experimental Farm, Brandon, Man., is much more uniform and somewhat more upright than Common Yellow. It flowers a few days earlier than Arctic. At a number of Experimental Stations and Farms on the Prairies, Erector has been yielding more per acre than Arctic.

Aura ***(Melilotus officinalis)***.—Aura was selected from Common Yellow at the University of Manitoba. It has been found to be very similar to Erector in type, height and yield.

Madrid ***(Melilotus officinalis)***.—This yellow blossom variety has been introduced from the U.S.A. It is not recommended because it is not entirely winter hardy. When Madrid survives the winter it will yield about the same as Erector, both for forage and seed. It is somewhat coarser and taller growing than Erector.

Redfield Yellow ***(Melilotus suaveolens)***.—This variety is three to four weeks later in maturity than Arctic sweet clover. It is a tall growing, leafy variety with somewhat coarse stems and will yield slightly more hay per acre than the other varieties.

Hubam ***(Melilotus alba)***.—This is an annual white blossomed variety. It is not recommended in Western Canada because of its extremely low yield. It is late in maturity and seldom matures seed in Western Canada. The flowering period is an extended one and therefore this variety is occasionally used as a bee pasture.

Melana ***(Melilotus alba)***.—This variety is an annual white blossomed alpha type. It is also very low in forage yield and so is not recommended. Melana does mature earlier than Hubam and a seed set is obtained quite regularly. In this case also the flowering period is very long and hence it has some value as a bee pasture.

TABLE 1. Yield of forage in tons of dry matter per acre, of some of the sweet clover varieties grown at Saskatoon, 1953–1955

	Varieties					
Year	Arctic	Alpha	Brandon Dwarf	Erector	Aura	Madrid
1953	1.44	1.56	1.30	1.83	2.39	1.78
1954	2.47	1.72	1.69	2.53	2.56	2.63
1955	2.87	2.52	3.08	3.11	2.49	2.02
3-year average	2.26	1.93	2.02	2.49	2.48	2.14

Seed yields are given in Table 2 for the past 3 years. The yellow blossom varieties appear to have considerable advantage in seed production over the white blossom varieties. The white blossom varieties are about one week to ten days later than the yellow blossom varieties and in 1954 the early seed set very well but there was very little good seed-setting weather after the white blossom varieties flowered.

TABLE 2. Seed yields in lb. of clean seed per acre of some of the sweet clover varieties grown at Saskatoon, 1953–1955.

	Varieties					
Year	Arctic	Alpha	Brandon Dwarf	Erector	Aura	Madrid
1953	624	473	543	587	580	461
1954	103	29	90	562	434	536
1955	549	347	608	577	705	718
3-year average	425	283	414	575	573	572

Seeding the Crop

Quality of the Seed

In order to get good uniform stands of sweet clover it is essential to sow only seed of good quality. The term quality here refers to percentage germination, seedling vigor, and freedom from weeds and other impurities. Before sweet clover seed can be legally offered for sale in Canada it must be covered by a control sample certificate which, in addition to stating the grade, shows the kind and number of weeds present and the percentage germination. It is therefore wise to sow only graded seed. Growers may have their own seed graded by sending a sample (3 ounces) to a laboratory of Plant Products Division, Production Service. In the Prairie Provinces laboratories are located at Edmonton, Saskatoon, and Winnipeg.

Seed Treatment Prior to Seeding

Scarification—The seed coat of sweet clover seed is very hard. Unless the coat is chipped or cracked water cannot enter and the seed will not germinate. The process of chipping or cracking the seed coat is called scarification. The amount of unscarified seed in a threshed sample may be as high at 90 percent. Seed shattered to the ground is usually 95 to 100 percent "hard". When unscarified seed is sown portions of it may germinate year after year for probably 20 years or more. This accounts for the weed-like behavior of volunteering, and explains why it is highly important to use only well-scarified seed.

Seed companies generally have special equipment for scarifying sweet clover seed. On the farm the grain crusher is the most convenient means of accomplishing this. The plates should be adjusted so that a small percentage of the seed is ground.

It is advisable to determine the percentage of scarification in the seed to be sown. This can be done simply and quickly by placing a sample of seed in water for about 24 hours. Scarified seed will swell to 2 to 3 times the size of unscarified seed. This size difference permits an estimate or actual determination to be made quickly of the percentage of scarified seed. Ninety-five to one hundred percent of the seed should be scarified.

Inoculation of the Seed

Certain bacteria, when present in the soil, infect the roots of sweet clover. Their presence is indicated by small swellings on the roots. These enlarged areas are commonly called nodules. The presence of nodules on the roots indicates that the sweet clover plants are able to make use of the nitrogen in the air for growth and for enriching the soil. If nodules do not develop the plants are unable to use atmospheric nitrogen, consequently maximum yields may not be obtained and the soil may actually be impoverished rather than improved by the sweet clover crop. It is thus advisable to inoculate the sweet clover seed before it is sown. The increased production of nodules that results from inoculation will be very beneficial and the cost involved negligible. The simplest way to inoculate the seed is to use pure bacterial culture which may be purchased from seed houses. Full directions for application are supplied with each lot of inoculum. When ordering the culture always state that it is to be used for sweet clover as the inoculum for sweet clover is different from the inoculum for some of the other legumes. The bacteria in the inoculum gradually die off and so a date is given on the container after which the culture should not be used.

Use of a Nurse Crop

Whether sweet clover should be sown with a nurse crop or not depends upon soil moisture conditions during the growing season and upon the purpose for which the sweet clover is being grown. Satisfactory stands of sweet clover can usually be obtained in the black and gray wooded soils using a nurse crop while in the dark-brown and brown soils the use of a nurse crop will often cause the sweet clover stand to fail. When moisture is limited the annual crop, because of its ability to develop faster than the sweet clover, is able to use most of the available soil moisture and crowd out the slower growing biennial. Sweet clover plants under these conditions either develop poorly during the first year or produce low yields the following year. Before using a nurse crop with sweet clover the grower should consider carefully moisture reserves, type of soil, and the relative importance of the nurse crop and the sweet clover. If the soil is very light in texture it may be better to seed without a nurse crop (even in the northern soil zones), but if the soil is heavy good stands with a nurse crop can often be obtained in Brown and Dark Brown soil zones.

To reduce competition it is important that the nurse crop be sown at not more than one half to two thirds the normal rate. In most instances the reduction in the yield of the nurse crop will not be very great but survival of the sweet clover will be greatly increased. When the nurse crop is removed in the fall of the first year the crop should be cut high enough to leave as much of the green sweet clover plant as possible, as it is during late August that the plant forms winter buds in preparation for winter survival. If the top growth is removed these buds are not adequately formed and winter killing will result. In recent years the use of the combine for harvesting the nurse crop has resulted in more of the green plant remaining in the higher stubble and consequently better winter survival of the sweet clover.

If a nurse crop is used it is well to select a kind and variety that will offer the least possible competition to the sweet clover seedlings. Crops that shade the ground least and that produce relatively small root systems are least harmful. Most varieties of wheat are better than the standard varieties of oats or barley. Flax is preferred to any of the cereal grains. Early maturing varieties have the advantage of early harvest, which leaves a longer growing period for the sweet clover between harvesting the nurse crop and occurrence of killing frosts. The practice of harvesting the nurse crop early for hay or sheaf feed is recommended wherever possible.

Preparation of the Seedbed

In preparing the seedbed for sowing sweet clover, the grower should try to prevent soil drifting, to make the soil firm, and to conserve moisture. Drifting soil will quickly destroy the young seedlings and every precaution must be taken to prevent injury from that source. A firm seedbed makes it possible for the grower to control the depth of seeding, and thus avoid deep seeding which is a common cause of failure. Seed placed into loose, open soils, even when sown shallow, germinates unevenly and the resulting stand is likely to be thin and patchy. Because of their small size the seeds of sweet clover must be sown into the top inch of soil, and since moisture is essential for germination it is necessary to plan the seeding operation to take advantage of favorable moisture conditions which may exist at any particular time.

Method of Seeding

Under dry land conditions it is essential that the seeds be drilled into soil. The broadcast method of seeding which scatters the seeds on the surface, to be later covered by harrowing, has not given as satisfactory results as drilling the seed.

When seeding without a nurse crop a grass seeder attachment is very valuable. However, new drills and those with a forced feed will seed sweet clover at a desired rate. Old drills usually sow this crop much too heavily unless mixed with a bulky material such as cracked grain. The proportions for this mixture are about one pound of clover seed to three pounds of cracked grain.

If seeding with a nurse crop the sweet clover can be mixed with the grain in the proper proportion, or fed separately into the drill spouts with a grass seeder attachment. Since shallow seeding of the sweet clover is essential the cereal must be sown at less than one inch in depth by this method. If it is desired to seed the nurse crop at the usual depth, it may be sown alone, and then the sweet clover seed sown at the necessary depth. This is a good practice but requires more work. Under good moisture conditions the sweet clover may be sown broadcast and the nurse crop sown in the usual way. After broadcasting the seed should be covered by harrowing followed if possible with the packer.

Time of Seeding

Under dry land conditions seedings made just as early as the land can be tilled in the spring have the advantage of favorable moisture conditions resulting from spring thaws. Occasionally some of the seedlings may be injured by late spring frosts but damage from that source is usually more than compensated by the fact that the sweet clover gets a start before the surface soil dries out.

On the heavier types of soil, seeding may be delayed until later in the spring with a view to destroying weeds and avoiding damage from cutworms. Late spring seedings are most successful if done as quickly as possible following a good rain. On the lighter soils, particularly the fine sandy loams and sands, late spring seedings are usually not successful, since these soils dry out quickly to a depth of several inches and the small roots of the seedlings are left in dry soil.

Fall seeding of sweet clover is not recommended. Early fall seedings where the crop goes into the winter in the seedling stage will invariably kill out, as the seedlings are not hardy. Late fall seedings, made late enough that the seeds will not germinate until the following spring, although occasionally successful, are very often severely damaged by early spring frosts.

Rate of Seeding

The rate of seeding is governed to some extent by soil moisture conditions. Heavier rates of seeding may be practised advantageously in the more moist areas as an aid in obtaining a finer quality hay. The lighter rates are better where moisture conditions are less favorable. When the crop is sown in drill rows spaced about 6 inches apart, from 12 to 15 pounds of seed per acre are required. When sown in widely spaced rows, about 30 inches apart, primarily for seed production, 3 to 4 pounds of seed per acre are sufficient.

To determine whether the drill is set correctly weigh out two or three lots of seed of the amount to be sown per acre. Put one lot in the drill box, but before doing so fill the cups level full. When the seed has been used down to the level of the top of the cups, one acre should have been sown. The acreage actually sown can be checked on the drill tally or can be calculated from the drill width, the length of strip sown and the fact that there are 43,560 square feet in an acre. By testing the drill setting in this way two or three times and making adjustments, the desired rate can be obtained.

Depth of Seeding

Deep seeding has been responsible for many failures with sweet clover. The seeds must be sown at a shallow depth. On the heavier soils they should not be sown deeper than one-half to three-quarters of an inch. On the lighter soils the maximum depth is one inch. Table 3 shows the results of some carefully conducted depth-of-seeding tests.

These data show clearly that deep seedings are certain to fail. Sweet clover must be sown at a shallow depth and at a time when moisture conditions in the surface soil are likely to be most favorable for germination of the seeds.

TABLE 3. The effect of depth of seeding sweet clover upon the emergence of the seedlings.

Depth of seeding (inches)	No. of days from seeding to emergence	Uniformity of emergence	Condition of seedlings	Percentage emergence
½	4	Very uniform	Strong	98
1	5	Very uniform	Fairly strong	88
1½	6	Fairly uniform	Weak	46
2	7	Uneven	Very weak	20
2½	9	Very uneven	Yellow and spindly	2
3	None emerged			0

Treatment During the First Year

When sown without a nurse crop, sweet clover may be cut back with the mower during the year of seeding to prevent annual weeds from maturing seeds. It is not advisable to mow the crop later than early August and the cutting bar of the mower should be adjusted to cut high and thus remove the least possible amount of sweet clover foliage. As previously mentioned sweet clover is very susceptible to 2,4-D and annual weeds cannot be sprayed without extensive damage to the crop.

When sown with a nurse crop it is desirable to cut the nurse crop as early as possible and run the cutting bar high enough that none or as little as possible of the sweet clover foliage is removed. If the nurse crop is harvested with a combine it should be equipped with a straw spreader. This is particularly important in heavy grain crops as a heavy windrow or swath of straw will generally smother the sweet clover plants under it.

Light pasturing during the year of seeding is permissible only after the plants have been damaged by fall frosts and have ceased to grow. As a rule, pasturing done prior to October 10 will interfere with the storage of food in the roots and is likely to result in decreased yields of sweet clover the following year.

Sweet clover sown in widely spaced rows, primarily for seed production, should receive its first cultivation as soon as the seedlings are large enough to mark out the rows clearly. Care must be taken to cultivate shallowly at this stage. If the cultivator is provided with guard plates it is possible to cultivate quite close to the plants without causing injury. Cultivations should not be more frequent than is necessary to keep down weed growth.

Sweet Clover Poisoning

A condition known as "sweet clover disease" in cattle frequently results from the feeding of spoiled sweet clover hay or ensilage. When sweet clover hay and ensilage spoil a chemical change takes place which results in the production of a substance that when fed to animals brings about an increase in the normal clotting time of the blood. Consequently, animals fed on spoiled sweet clover may bleed to death from minor wounds, dehorning, castration, or when calving. In severe cases internal hemorrhages may occur.

Experiments have shown that cattle, when pastured even for long periods on sweet clover, show no symptoms of this disease. Furthermore, the feeding of bright, well-cured sweet clover hay or well made sweet clover ensilage appears to be quite safe. It is the poorly cured, moldy hay or silage that is dangerous. Spoiling sweet clover hay in the stack may often be indicated by a very strong odor and craters forming in the stack. Spoiled sweet clover hay usually becomes blackened or very dark in appearance. Occasionally, however, toxic hay does not show signs of spoilage and thus care must be taken if spoilage is at all suspected.

Sweet clover disease has occurred rarely in Western Canada, but it is a good practice to feed some other roughage along with sweet clover hay. It is also advisable to take the stock off sweet clover feed entirely about three to four weeks before dehorning, castration, or any other minor operation, or when cows are to calve.

Melilot Taint

Melilot taint of wheat, also often referred to as sweet clover taint, has caused considerable loss to farmers in some years in the form of lowered grades. It is caused by volunteer plants of sweet clover in the wheat fields being harvested with the wheat. If these sweet clover plants are green or if harvesting is done in wet weather the grain absorbs the characteristic penetrating odor of sweet clover.

To avoid melilot taint farmers should take the following precautions against volunteer sweet clover plants in wheat fields:

(1) When growing a sweet clover crop use only well-scarified seed and sow at the recommended shallow depth. Early seeding so that moisture is available, encourages uniform germination.

(2) Where the sweet clover is to be used for hay cut when flowering starts so that seed is not allowed to form. Immediately after cutting the hay plow the crop down.

(3) When the crop is kept for seed give the field a shallow surface tillage, after the seed crop is removed, to induce fall and spring germination. The following year plow the field about mid-June and fallow for the rest of the season.

(4) Keep roadsides and headlands free of sweet clover.

(5) If, in spite of all precautions, there is a heavy infestation of sweet clover seedlings in the crop they may be killed readily with an application of 5 or 6 ounces of 2,4-D. If the sweet clover is allowed to persist until its second year it will be more difficult to kill with 2,4-D.

(6) If sweet clover is present in the wheat fields harvest the crop only when the sweet clover is completely dry. Clean the grain from such fields immediately after threshing to remove any clover leaves or stems. Wheat from a field having volunteer clover should not be mixed with wheat from a clean field.

Insect Pests of Sweet Clover

The most serious insect pests of sweet clover are cutworms, grasshoppers, and sweet clover weevil. Common control methods for cutworms and grasshoppers usually control these insects whereas with sweet clover weevil, which is by far the most serious, special measures have to be taken.

Sweet Clover Weevil—The adult clover weevil (*Sitona cylindricollis* Fahr.) is a small, dark gray, snout beetle about three-sixteenths of an inch long. The adult weevils attack the leaves of sweet clover in the spring and fall, and the larvae feed on the roots during the summer. The damage to the leaves is readily recognized by the characteristic crescent-shaped pieces eaten out of the leaves. The weevils themselves are often hard to find as they drop to the ground when disturbed and remain quiet. When damage is severe the whole plant may be stripped of its leaves. In seedling material all or most of the leaves may be eaten off, in which case the plants die. The weevil is thus a common cause of failure of stands. Damage in the second year is often less serious as the plants can usually outgrow the damage if there is sufficient moisture. In certain areas, however, the weevil may keep second-year plants so eaten down that they will be unable to recover in the spring even under good growing conditions.

Control: Several insecticides are effective against the sweet clover weevil, but ½ lb. of active ingredient per acre of *heptachlor* or *dieldrin* will give excellent control. The costs of these insecticides must be balanced against the value of the crop protected. D.D.T. at 1½ to 2 lb. of active ingredient per acre has given good control but does not protect the seedlings so well as the other chemicals mentioned above.

Sometimes it is necessary to spray the crop as the first-year seedlings are emerging or the weevil will eat the plants as they show above ground. The field must be carefully watched after seeding to ascertain whether or not spraying is necessary.

The emulsion spray can be applied with the ordinary low pressure, low volume sprayer, commonly used to apply 2,4-D for weed control in cereal crops. Because sweet clover is very readily killed by 2,4-D, sprayers that have contained the weed killer should be thoroughly cleaned with household ammonia, soap and water, and then rinsed thoroughly before being used to spray sweet clover.

Cultural control is often a more practical and inexpensive method. Shallow surface tillage in late July, after removal of the hay crop of sweet clover, that will expose the larvae and pupae to heat and drying, is most effective. The practice has been found to reduce the population as much as 98 percent. This is also good agronomic practice as it provides a partial summerfallow. Crop rotation should include crops such as cereals, upon which the weevil does not feed.

If sweet clover is planted a distance from a second-year sweet clover it will escape heavy fall migrations and damage. Any marginal strip of defoliated sweet clover should be plowed in the fall to a depth of 6 inches. This buries the hibernating weevils so that few emerge in the spring. The defoliated sweet clover would not emerge in any event and the strip should be sown to grain or other crops.

WARNING—D.D.T., heptachlor, or dieldrin should not be used on any sweet clover foliage that is to be used later for hay or silage.

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